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SYSTEM FOR TRANSFER PRINTING, IN PARTICULAR GILDING

Background of the Invention

The present invention relates to a system of transfer printing, in particular for gilding, a motif lifted from a transfer film by a die, which is to be affixed on a receiving strip to form a product, the transfer film and the receiving strip being synchronised at the transfer station at the instant of transfer.

Such systems or the methods of transfer corresponding to such a system are known. They consist of hot transfer printing systems operating on the conventional principle of what is known as gold leaf gilding.

A gilding iron M is used for this process (figure 1A), the bottom face of which bears the imprint to be applied in the form of a gilded imprint onto a strip B of paper, for example. To this end, a transfer film F, is pressed against the strip B and some parts of it, corresponding to the relief of the gilding iron M, are detached and remain adhered to the strip B.

Traditionally, the transfer film F was an extremely thin sheet of gold, which was applied hot with a pressing element, such as a gilding iron (M), against the paper or leather substrate (strip B). The outline or mark of the gilding iron remains adhered to the strip B and the parts of the film F which are not adhered are simply removed by peeling them off.

This hot gilding process is used only for bookbinding, covering and similar activities involving luxury work or for restoring antique objects.

In many cases, the gold film is replaced by a system comprising a base film C1 provided with a dividing layer C2 which adheres to the layer to be transferred C3, C4, which may be metallic or coloured. The layer to be transferred C3, C4 may be a coloured layer C3 and a metallic layer C4 with an adhesive layer C5.

When pressed onto the transfer film F, the gilding iron M is itself in contact with the strip or more generally the substrate B to which print is to be applied. When the gilding iron M is pressed onto the transfer film F, already in contact with the strip, or more generally the substrate B, the compressed parts of the film F

adhere to the latter B (fig. 1B). Then, as explained, the iron M is removed and only the imprint formed by the layers C2, C3, C4, C5 adhere to the strip B, whilst the parts F, G that were not compressed by the iron M are torn away by shearing and separated from the imprint E, remaining adhered to the base C1 (Fig. 1C). This compression is effected against a support or pressing element P.

This known technique is applied discontinuously by a continuous leaf by leaf printing process, whereby a receiving strip and a gilding film (transfer film) are fed between two cylinders, one of which is a contact cylinder and the other a heated cylinder bearing one or more dies. The two cylinders rotate in opposite directions and, as the strip and film are fed through, the die prints onto the strip. On leaving, the transfer film together with the unused part of the transfer product is reeled.

The disadvantage of this system is that it consumes a lot of transfer film, i.e. a length of transfer film equal to that of the receiving strip, given that the surface of the transfer film actually used to produce the motif represents only a very small fraction of the total surface area of the transfer film.

Summary of the Invention

The objective of the present invention is to remedy this drawback and a means is proposed whereby hot gilding operations or operations of a similar nature can be performed by transfer in such a way that the consumption of transfer film is the same as that of the gilding or sheet-by-sheet transfer whilst being faster and enabling this method to be used for other applications such as holography and anti-theft security features.

To this end, the invention relates to a transfer printing system corresponding to the type defined above, characterised in that it comprises

- a means for driving the transfer film,
- a means for driving the receiving strip,
- a transfer station,
- a control means which controls the drive means, whereby the drive means of the film feeds the film forward by a step corresponding to the motif to be transferred and the drive means of the receiving strip feeds said strip forward by the step of the product in readiness for each transfer, as well as

the transfer means of the transfer station.

The advantage of the system proposed by the invention is that it consumes only exactly the length (or surface) of transfer film needed to produce the motif on the receiving strip. The control system of the drive means enables this system to be adapted directly online to an upstream printing system or a pre-printed strip, unwound from a reel, to be processed. With the same degree of efficiency, the same output and the same degree of economy, the system enables extremely different motifs or several motifs to be printed by transfer.

By virtue of another characteristic of the invention, the transfer element at the transfer station is activated by a jack and the control means immobilises the film and the strip during the time in which the transfer is being operated.

In an alternative solution, the transfer means comprises at least one transfer element mounted on a rotary element and the means for driving the film and that of the receiving strip are controlled so as to drive the film and the receiving strip at the same speed as the peripheral speed of the transfer element during the time the transfer is being operated.

The choice as to which of these solutions to use will depend in particular on how much space is available and the type of motif to be transferred.

In either case, several transfer films and several transfer elements may be juxtaposed on a level with the transfer station to enable transfer films of different types to be used.

As a result of another feature, a first detector is assigned to the strip to detect the step of the product and supply a signal to the control means managing the forward movement of the strip; and the strip has pre-printed markers designed to be read by the detection means.

The marker is pre-printed on the receiving strip. It defines the position of the products to be made (labels, packaging), which will be cut to the requisite dimensions on leaving the system.

This pre-printed marker may be combined with a pre-printed image, in which case the motif obtained by transfer must be positioned exactly relative to the pre-printed image; the marker may also be nothing more than a marker enabling the

forward feed of the strip in the transfer station to be controlled.

If the transfer involves not just a motif which is merely transferred from the blank transfer film but also includes a motif applied to the transfer film beforehand, the transfer film and in particular the pre-printed motif which it carries with it to the transfer station must be positioned absolutely accurately and, this being the case, the invention offers another advantage in that a second detector is provided to detect the motif of the film and supply a signal to the control means managing the drive means of the film.

Depending on the system requirements, the products to be made and the nature of the transfer films and receiving strips, the means for driving the film and that for driving the receiving strip may both operate step by step; alternatively, one may be operated step-by-step and the other continuously or both may be operated continuously, at variable speeds depending on the stage of the operating cycle.

By virtue of another advantageous feature, the system has several means for driving films so that several motifs can be transferred to the receiving strip simultaneously or in succession. This might be necessary for the reasons already explained above, due to the nature of the motifs to be transferred. It might also be of use if the motifs to be transferred are distributed across the receiving strip at points some distance from one another in order to avoid too large dimensions and, as a result, too high an inertia as would occur if a single transfer element were being controlled by a single jack.

As a result of another advantageous feature, the transfer element is a cylinder, which prints the successive motifs with an offset in order to reduce overlapping thicknesses when the strip is reeled or the sheets cut from the strip are stacked after the transfer.

This offset between successive transfer elements is useful in situations where the printed motif adds extra thickness.

To this end, in a particularly advantageous manner, the transfer elements of the transfer cylinder are distributed around a cylinder with a circular section in an offset arrangement following a line corresponding to the intersection of the cylinder by an inclined plane (ellipse).

Brief Description of the Drawings

The present invention will be described in more detail below with reference to the appended drawings, in which:

- figures 1A, 1B, 1C show the three successive steps of a hot gilding operation known from the prior art, applied to a film in place of a gold film.

- figure 2 is a schematic view of a first embodiment of a transfer printing system as proposed by the invention,

- figure 3 is a schematic view of a second embodiment of a transfer printing system as proposed by the invention,

- figure 4 is a schematic side view of the system, illustrating the operating principle illustrated in figure 3,

- figure 5 is a plan view of the system illustrated in figure 4,

- figure 6 is a schematic view of a transfer printing system similar to that of figure 4 but for several transfer films, side by side,

- figure 7 is a side view of another embodiment of a transfer printing system,

- figures 8, 9 illustrate three examples of receiving strips with pre-printed motifs with security elements,

- figure 10 is a perspective view of a transfer cylinder.

Detailed Description of the Invention

As may be seen from figure 2, the invention relates to a system of transfer printing, in particular for hot press gilding, for printing a motif which is lifted from a transfer film 1 and affixed to a receiving strip 2. This system incorporates a means 3 for feeding and driving the film 1 and a means 5 for driving and feeding the receiving strip 2.

The drive means 3, consisting of a supply reel 31 and a take-up reel 32, feeds the transfer film 1 into a transfer station 4 consisting of a die 41 controlled by a jack 42 and supported against a support surface at the transfer station, not illustrated, to support the receiving strip during the transfer process.

The drive means 3 for the transfer film 1 feeds the film forward, transversely to the feed direction of the strip 2, each time by a length L1

substantially corresponding to the length of the motif to be transferred. Once transferred, this motif 21 leaves a marking 11 on the transfer film 1, as may be seen in the part of the film downstream of the station 4; the feed direction of the transfer film 1 is indicated by arrow A.

The feed and drive means 5 of the receiving strip 2 has a supply cylinder, not illustrated, located in the right-hand part of figure 2. Unwound in the direction of arrow B, the strip 2 is driven by two intake cylinders 51, 52 downstream of the transfer station 4; these cylinders are driven by a stepper motor upstream of the station 4, for example, by two cylinders 53, 54 continuously feeding the receiving strip 4; these cylinders 53, 54 are followed by another pair of cylinders 55, 56, after which a loop 57 is formed to compensate for the step-by-step action on a level with the transfer station 4 as the product arrives at constant speed.

At the end of the line, the products 22 are cut by a cutter 6, schematically illustrated by a blade. These products may be labels, packaging or similar products.

The system is managed by a control means 7 linked to the drive means 3 of the transfer film 1, the drive means 5 of the receiving strip 2, the transfer station 4 and the cutter 6 by lines, not shown by reference numbers, linked to the different means and motors, which are also not illustrated.

This control means 7 receives operating data as well as the signal S issued by a sensor 71, which detects markers 23 carried by the strip 2. These markers 22 define the position of the motifs 21 and products 22 on the receiving strip 2.

Depending on the signal S from the sensor 71, the control means 7 causes the receiving strip 2 to move forward by a distance of the step L2 of the product 22 on a level with the transfer station 4 and immobilises the part of the strip 2 located at this point. At the same time, the control means 7 causes the transfer film 1 to be moved forward in the transfer station 4 by a step L1. The film 1 and strip 2 are then immobilised whilst the die 41 prints the motif onto the strip 2 and is then lifted off again.

After this lifting action, the film 1 is no longer in contact with the strip 2. The drive means may then move the transfer film 1 forward by a step L1 and the receiving strip 2 by a step L2.

The step L2 of the strip 2 depends on what products are being made. These products 22 are joined, as may be seen on a level with the cutter 6.

The step of the transfer film 1 is limited to the length L1 of the motif to be transferred. In the simplest of cases, the film 1 crosses the strip 2 at a right angle on a level with the station 4. This layout is basic but there are other variants. In practice, to transfer a motif which fits inside a rectangular frame with the same elongation as the motif 21, it is more practical to opt for the layout illustrated and juxtapose the markings 11 on the film as close together as possible; if the motif is inscribed within a parallelogram, it may be more practical to incline the arrangement at a corresponding angle, again with a view to reducing the gap between the markings 11 to a minimum; this situation might occur in the case of a word in italic type, for example.

The receiving strip 2 is a strip of printed paper, for example. The print may be applied by gravure printing groups in an online rotary process on the system illustrated in figure 3. Consequently and in order to make allowance for the fact that the strip 2 is fed at constant speed, the loop 57 is formed upstream of the cylinders 53, generally speaking between the last printing group and the transfer printing unit.

The operations which take place at the transfer station 4 each time the strip 2 is halted are as follows:

- the transfer film 1 is fed forwards by a step L1,
- the transfer element 41 is lowered,
- the pre-printed receiving strip 2 is positioned,
- the transfer element 41 is pressed down onto the transfer film 1 in order to apply it against the receiving strip 2,
- the transfer element 41 is raised again,
- the transferred part is detached and separated from the transfer film 1 and forms the motif,
- the receiving strip 2 with a motif thus transferred is fed forwards,
- the strip 2 is cut
- the transfer film is reeled back onto the reel 32 by the length of a step L1.

This sequence of operations is repeated in synchronisation with the printing groups downstream of the transfer printing station and the cutting of the receiving strip downstream of this station.

It should be pointed out that this system may be applied in general terms to the transfer of a motif from the transfer film 1 to the receiving strip 2 timed to any step chosen for the receiving strip 2 and the material of the transfer film 1 may be economised to the maximum by reducing the step L1 to the strict minimum.

In particular, these operations may be used to produce gilding, in which case the transfer film will have a structure similar to that described in relation to figure 1A, i.e. it will consist of a base of polyester, for example, a dividing layer, a coloured layer, a metallic layer and finally an adhesive layer. Viewed in this order, this structure corresponds to the disposition of the transfer film illustrated in figure 2. The base film is located on the top, on the side of the transfer element 41, whilst the adhesive layer is located on the side of the receiving strip.

Depending on the nature of the transfer film, the transfer element 41, operated by pressure, may be cold or hot. If operated hot, the element is fitted with an integrated heating means, not illustrated, for example an electrical resistor, operating under the control of a temperature regulator in order to keep the transfer element at the requisite transfer temperature without the risk of spoiling the transfer motif or receiving strip 2 by too hot a gilding iron.

The receiving strip 2 may be pre-printed, as mentioned above.

The motif to be transferred is applied to the transfer element 41 and the transfer film is uniform, carrying no particular print.

Positioning of the motif on the receiving strip is regulated by the relative positioning of the receiving strip and the transfer element, taking account of the different operations to be performed upstream and downstream of the transfer.

Figure 3 illustrates another approach to operating a transfer printing system. This system operates in the parallel direction, i.e. the receiving strip 2 and the transfer film 1 circulate in the same direction. Figure 3 provides a schematic illustration of this system, shown in more detail in figures 4 and 5.

The same reference numbers as those used for figure 2 will be used for the description of figures 3, 4, and 5 to denote the same elements of the system. These references are suffixed with the letter A.

Turning to figure 3, the system comprises a supply roller 31A and a take-up roller 32A which feed the transfer film 1A into the transfer station 4A. This station 4A comprises a cylinder 41A provided with transfer elements 411A, 412A co-operating with a contact cylinder 42A. The receiving strip 2A and the film 1A pass through the gap between the cylinders 41A, 42A.

The two transfer elements 411A, 412A on the transfer cylinder 41A are plates.

The direction of rotation of the cylinder 41A and that of the contact cylinder 42A are indicated by arrows C, D.

The receiving strip 2A is fed continuously (arrows B) whilst the transfer film 1A is fed at the same speed as the strip 2A at the instant of transfer, when one of the transfer elements 411A, 412A applies the film 1A against the receiving strip 2A as it rotates. Outside of this synchronised phase, however, the transfer film 1 is fed forward only by a step corresponding to the length of the film to be used to make the transfer. This step essentially corresponds to the height of the motif to be transferred.

The receiving strip 2A has markers 23A to position the strip at the point at which it must be whenever the motif 21A is transferred. The marking 11A of the motif appears on the film 1A downstream of the station 4A. This arrangement with parallel feeding of the film 1A and the strip 2A makes the transfer station 4A more compact and allows several transfer films of different types to be placed alongside one another in order to apply several transfers to the same receiving strip simultaneously. The motif 21A may be of the type which appears and is automatically visible and a non-visible or coded motif constituting an anti-theft security measure. Since the two motifs are different in nature, they will be applied to and supported on a different base.

This parallel layout also enables a different number of motifs to be transferred to a same product, for example a legible motif 21A, such as a mark, and

several invisible or coded motifs 24A such as an anti-theft security feature, repeated along the edge or two edges of the product; in this case, the film 1A will be located between two other films, not illustrated in figure 3.

These motifs 24A are shown in a simple format and merely by way of illustration in figure 3 whereas the transfer elements and the transfer film for producing them are not illustrated but are disposed across the width of the transfer film 1A.

Figures 4 and 5 provide a more detailed illustration of the system shown in figure 3.

Here, in addition to the means already described above, the system has, upstream of the transfer cylinder 41A, a guide cylinder 33A with a contact foot 34A, controlled so as to retain the transfer film 1A downstream of the foot 34A once the film has been fed forward by a sufficient length to allow a transfer to be performed as contact is made between the transfer cylinder 41A and the contact cylinder 42A rotating in synchronisation.

After this, there are two intake drive cylinders 35A, 36A like those described in the system of figure 2, which draw the transfer film 1A along at variable speed depending on the operating phase (forward by a step and synchronous movement with the strip 2A for the transfer process).

This variable speed feed action is compensated by a sliding system 37A formed by two cylinders 371A, 372A with, in the gap in between, a cylinder 373A loaded with a weight to form a variable length loop. Finally, the take-up cylinder 32A receives the film 1A downstream of the transfer station 4A.

For reasons of space and access, the contact cylinder 42A is in a raised position and closer to the film 1A in the transfer station 4A than along the rest of the route travelled by the strip 2A upstream and downstream of the cylinder 42A; the deflection is produced by two auxiliary cylinders 421A, 422A.

The shoe 34A is controlled by the central control system 7A, for example, which is illustrated schematically and to a limited extent only; the detector 71A for the markers 23A on the strip 2A is shown in figure 5. Figure 5 also shows the motifs 25A printed on the strip 2A before it receives the transfer or transfers 21A.

As may be seen from the plan view of figure 5, the transfer film 1A occupies only a fraction of the width of the strip 2A. Other transfer films with different materials may be placed alongside this first transfer film 1A to produce other transfers.

Figure 5 also shows the drive motor 413A of the cylinder 41A and that 351A of the cylinder 35A.

A similar situation is also schematically illustrated in figure 6, which shows the part of the system limited to the transfer station 4B and the upstream and downstream means. As above, the reference numbers used in figure 6 are the same as those above suffixed with the letter B. The two supply cylinders are shown by references 31B, 31'B and the take-up cylinders by references 32B, 32'B. The other parts of the system are identical or similar to those illustrated in the previous drawings and will not be described in detail.

Figure 7 illustrates another embodiment of the system for transferring pre-printed motifs onto the transfer film. The same reference numbers will be used in this part of the description, suffixed with the letter C, to denote means that are the same or similar to those described above, the description of which will only be given partly.

This system is used for transferring "pre-printed" motifs onto the transfer film 1C; these may be simple motifs but in particular are complex motifs which are applied or affixed to the transfer film 1C, which could not be achieved using uniform film and a simple hot or cold transfer pressing system, and include motifs of the hologram or magnetic marker type such as the motifs 24A (fig. 3) in addition to motifs applied by a simple transfer such as motifs of type 21A.

All other features of the system (fig. 7) being the same, the position of the motif 14C on the film 1C upstream of the transfer station 4C must be detected. It is detected by the detector 72C, which supplies a signal S1 to the control system 7C; the latter controls the motor 351C of cylinder 35C in the group of intake cylinders 35C, 36C, issuing a command to feed the film 1C forward step by step, and, when the motif 24C is on a level with the transfer element 411C, 412C of the transfer cylinder 41C, move it in synchronisation with the strip 2C for the time

needed to make the transfer.

The speed differences between unreeling from the roll supplying film 31C (supply reel) and the film 1C consumed in the transfer station are absorbed in the sliding system 9C comprising two stationary cylinders 91C, 92C and a cylinder 93C loaded with a weight and applying a constant tension to the film 1C.

The system managed by the control system 7C receives the detection signals S1, S2 from the detectors 71C, 72C detecting the markers 14C, 24C carried by the film 1C and the receiving strip 2C.

Figure 8 illustrates a receiving strip 2D on which images 25D and markers 23D have been printed. The transfer applied to this strip has coded motifs 24D, for example holograms.

Figure 9 illustrates a receiving strip 2E provided with a printed image 25E and markers 23E as well as motifs 24E, such as electromagnetic detection markers, as an anti-theft security feature.

In figures 8 and 9, the strips 2D, 2E are wound once the coded motifs 24D and electromagnetic motifs 24E have been transferred; they will be cut later, in a packaging installation, for example.

Since the motifs 24D, 24E may be slightly thicker by a certain degree on winding, it may be practical to transfer them onto the strip 2D, 2E at successive positions that will not be aligned when the strip is in the wound state, offsetting them transversely (relative to the axis of the winding reel), which can be done using a transfer cylinder such at that illustrated in figure 10.

This transfer cylinder 41F is mounted with transfer elements 411F, 412F distributed around two peripheral rings inside which the elements 411F, 412F are transversely offset. These rings may be ellipses, for example (a plane intersecting the cylinder 41F). In the example illustrated in figure 10, the transfer elements 411F, 412F of each unit are very close together.

The transfer elements 411F and 412F may contain extremely varied designs depending on the graphics to be transferred and the type of zone to be produced; for example a preferred format is that of making an antenna (24E), the effect of which will be optimised by amplifiers, or transferring printed circuits (24D).

In certain applications, the receiving strip 2D and 2E will therefore have motifs constituting a coating applied from the transfer film (1) and:

- graphics with a variety of colours, which may or may not be metallic, polychromatic motifs, holograms in which the graphic element is positioned relative to the transfer element (411 and 412) and the pre-printed strip (2),
- zones intended to permit binary recordings and/or to form an antenna of various shapes and dimensions incorporating amplifiers for example, in order to optimise the effect of a magneto-restrictive coating with a thickness of 25 to 900 Angström, designed to resonate in an alternating electromagnetic field generated at a selected frequency between 73 and 530 Hz and which will cause no resonance when deactivated,
- finally, and/or form printed circuits having insulating and conductive layers, one or more chips in order to transfer onto a strip 2D an antenna capable of recording, calculating and emitting in order to provide an intelligent marker.

The transfer strip (F), designed as a means of making antennas with an anti-theft feature, is advantageously made from a metallic layer (C4) of a metal mixture or an alloy with a base of cobalt, iron and boron or any other compound having magneto-restrictive properties, by metallizing under vacuum a polyester film (C1) coated with one or more dividing layers (C2), then covered with an adhesive (C5).